MicroLink

User and Installation Guide

1 Revision History

Revision	Date	Comments
A	6/23/2019	Initial release
B	07/17/2019	Modified the FCC and added the IC regulatory statement
C	08/09/2019	Updated the SkyStation statistics definitions and modified for uav files updating
D	08/12/2019	Updated the FCC and IC statements per the TCB
E	08/28/2019	Updated the RF exposure limits per the TCB

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2 Limited Warranty

uAvionix products are warranted to be free from defects in material and workmanship for one year from purchase. For the duration of the warranty period, uAvionix, at its sole option, will repair or replace any product which fails under normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor, provided that the customer shall be responsible for any transportation cost.

This warranty does not apply to cosmetic damage, consumable parts, damage caused by accident, abuse, misuse, water, fire or flood, damage caused by unauthorized servicing, or product that has been modified or altered.

IN NO EVENT, SHALL UAVIONIX BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE OR INABILITY TO USE THE PRODUCT OR FROM DEFECTS IN THE PRODUCT. SOME STATES DO NOT ALLOW THE EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

Warranty Service

Warranty repair service shall be provided directly by uAvionix.

3 Contents

4 Introduction

MicroLink is an aviation grade, miniature, Beyond Visual Line Of Sight (BVLOS) data link radio specifically designed for long range, robust, Unmanned Aircraft Systems (UAS) telemetry data links. Ideal for size, weight, power and performance sensitive applications, MicroLink operates in the 902-928MHz license-free ISM band.

5 Specification

5.1 MicroLink Radio Technology

- Dual radio architecture for true diversity
    - Path (spatial) diversity
    - Frequency diversity
    - Polarization gain
- Dynamic Medium and Multiple access, time and position synchronized, to support 100s of simultaneous links
    - Adaptive time and frequency spreading
- Global Positioning System (GPS) Coordinated Universal Time (UTC) link synchronization
- Status, integrity and health monitoring
- Environmental RTCA/DO-160G
- Software RTCA/DO-178C Level C
- Complex Hardware RTCA/DO-254 Level C
- FCC 47 CFR Part 15.247 ID 2AFFTC2XISM

Radio Specifications	
Band	902-928MHz ISM Band
Architecture	Dual Diversity Radios
Transmit Power	1W (4W EIRP)
Spreading	Code and Frequency
Bandwidth	200kHz
Receiver Sensitivity	
User Receiver	-118dBm
Control Receiver	-121dBm
Doppler Capture Range	±16kHz

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5.2 Regulatory Statements

5.2.1 FCC Statement

FCC ID: 2AFFTC2XISM

This device meets the FCC requirements for RF exposure in public or uncontrolled environments.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

5.2.2 Industry Canada Statement

IC ID: 25261-C2XISM

In order to comply with FCC / ISED RF Exposure requirements, this device must be installed to provide at least 20 cm separation from the human body at all times.

Afin de se conformer aux exigences d'exposition RF FCC / ISED, cet appareil doit être installé pour fournir au moins 20 cm de séparation du corps humain en tout temps.

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

(1) This device may not cause interference; and

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1) l'appareil ne doit pas produire de brouillage;

2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

5.3 Ground Radio System (GRS) – SkyStation

- All-Weather Network-Ready MicroLink GRS
- TCP and UDP Power Over Ethernet (POE) connectivity.
- IP67 grade enclosure.
- Dual Dipole Antennas
- Pole Mounting Kit

Specification	Value
Input Power	POE 13W Peak
Size	122x82x60mm
Weight	500 grams
Operating Temp	-45 to 70°C
Interfaces	
User	
Protocol	TCP or UDP
Control	
Protocol	TCP or UDP
Timing/Position	
Position	Internal
Environmental	
DO-160G	Temperature Cat B2
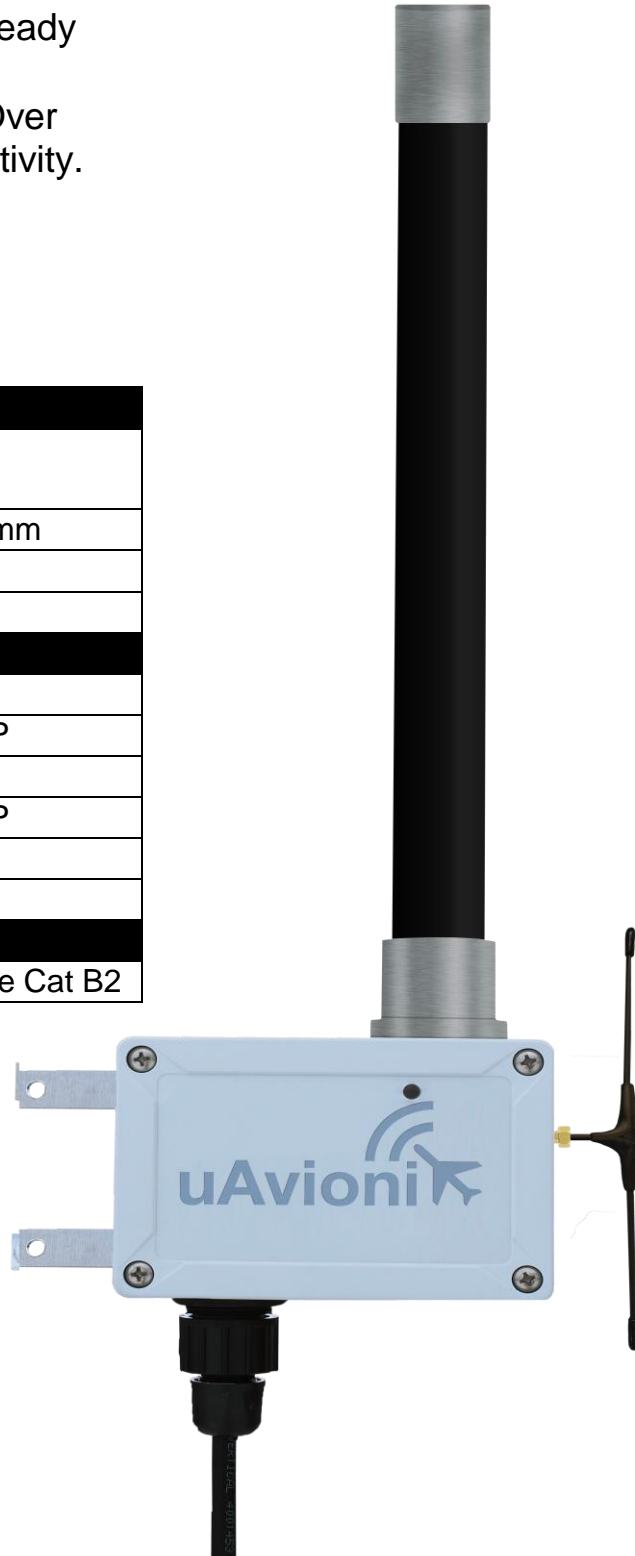
5.4 Airborne Radio System (ARS)

- Transparent serial user data interface
- Plug and play with Ardupilot PixHawk autopilot
- Dual MMCX antenna connectors
- Supports NMEA/UBX GPS Sensors such as HERE2 and truFYX

USER Interface

Pin	Type	Physical	Port
1	5V	5V	
2	RXD	IN	Telem
3	TXD	OUT	Telem
4	RXD	IN	GPS
5	PPS	IN	1PPS
6	GND		

Timing/Position, Control Interface

Pin	Type	Physical	Port
1	5V	5V	
2	RXD	IN	GPS
3	UTC	IN	1PPS
4	RXD	IN	Control
5	TXD	OUT	Control
6	GND		

5.5 Typical System Configuration
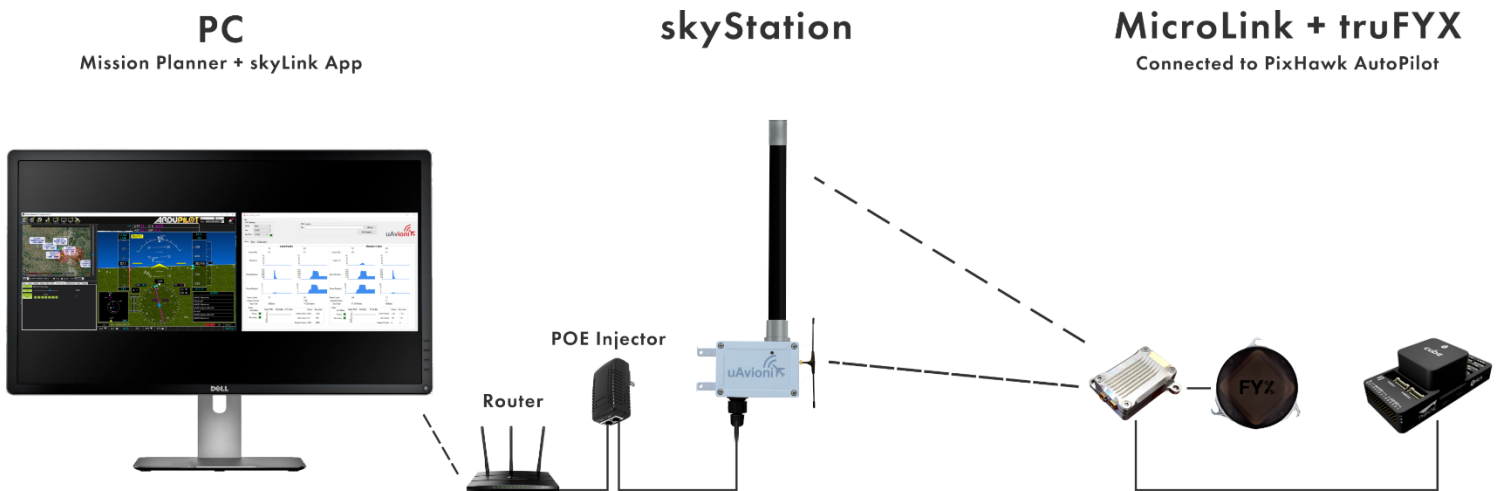
Ordering Part Numbers	
SkyStation	UAV-1003057-001
MicroLink	UAV-1002868-001
GPS Options	
truFYX kit	UAV-1002500-001
HERE2 kit	UAV-1002956-001
Replacement Parts	
SkyLink Dipole Antenna	UAV-1003060-001
MMCX 100mm	UAV-1003063-001
MMCX 200mm	UAV-1003063-002
GH 6p Cable	UAV-1003061001
GH 8p Cable	UAV-1003062-001

5.6 Mechanical Specifications

ARS

GRS

⌀50.80
SUPPORTS 0.75"-2"
DIAMETER PIPE

122

406

82

67

198

55

IP67 RJ-45
POE
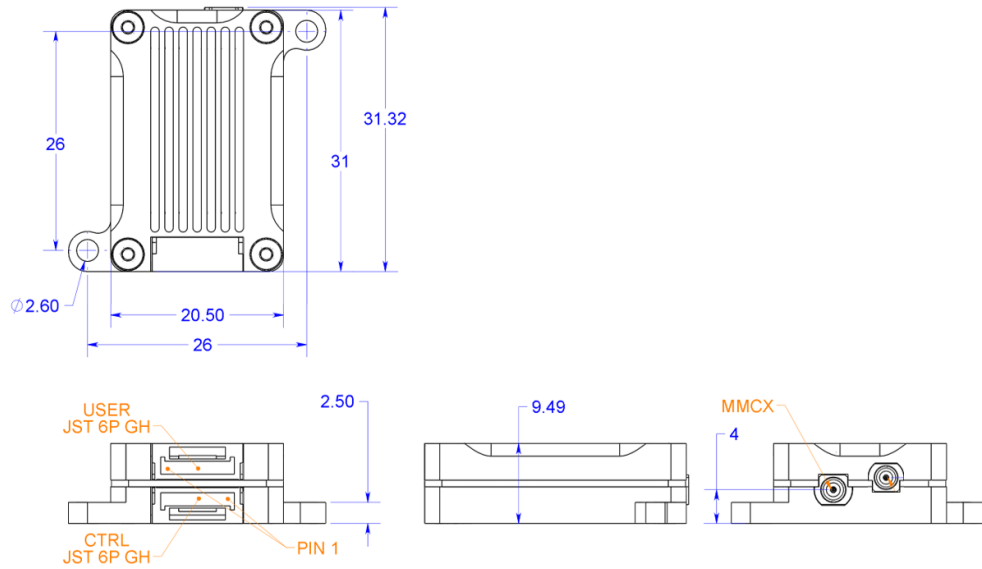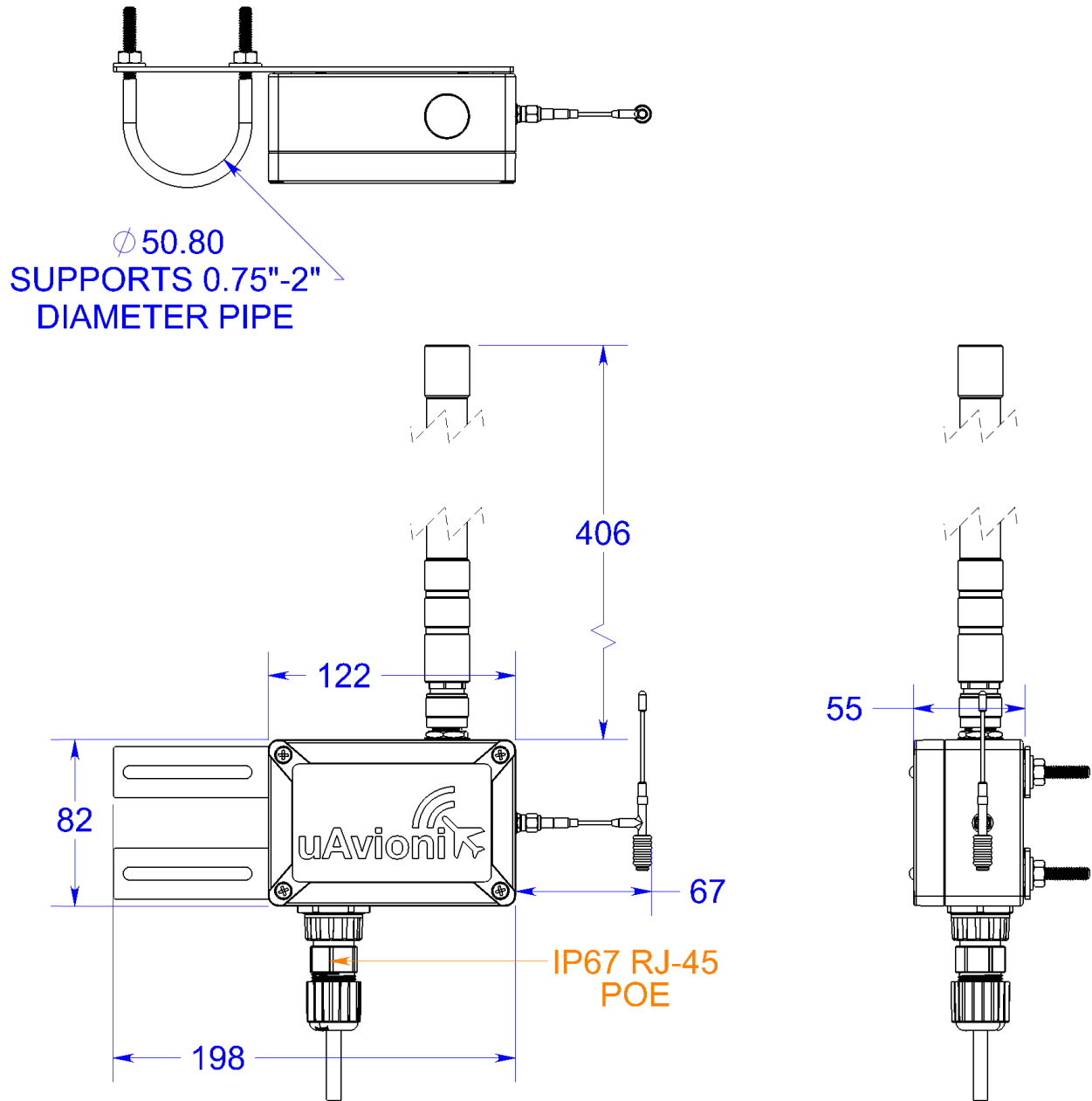
6 Configuration

6.1 SkyStation

Connect SkyStation to a POE switch or POE power injector.

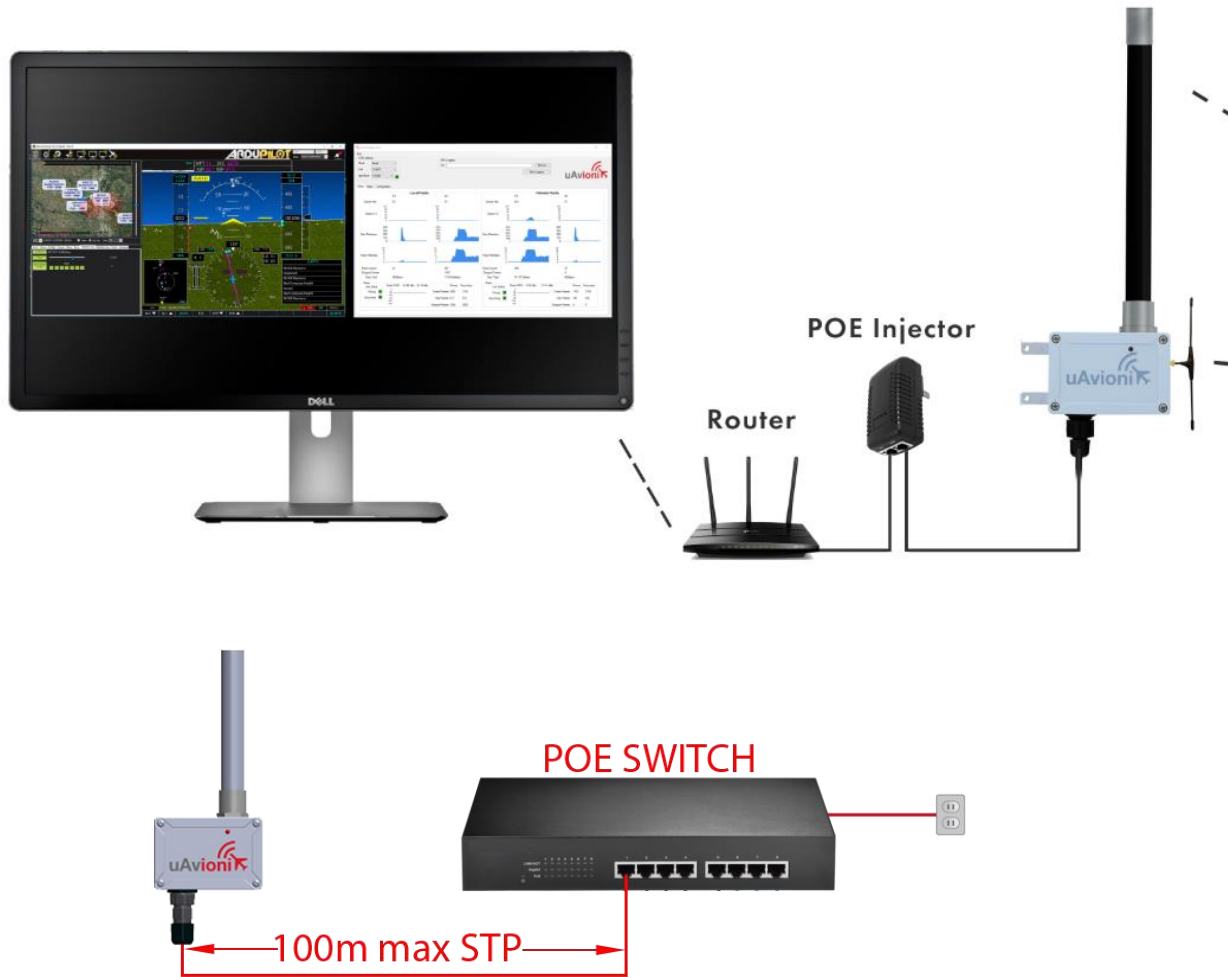## 6.2 Connection to the POE Network

POE Specifications:

Parameter	Value
Standard	803.3af (802.3at Type1)
Maximum power	15.4W
Voltage Range	37 – 57V
Maximum Current	350mA
Maximum Cable Resistance	20Ω
Supported Cabling	Shielded Cat 3 and Shielded Cat 5
Supported Modes	Mode A (endspan), Mode B (midspan)
Power Management	Power Class 0
Maximum Cable Length	100 meters

⚠
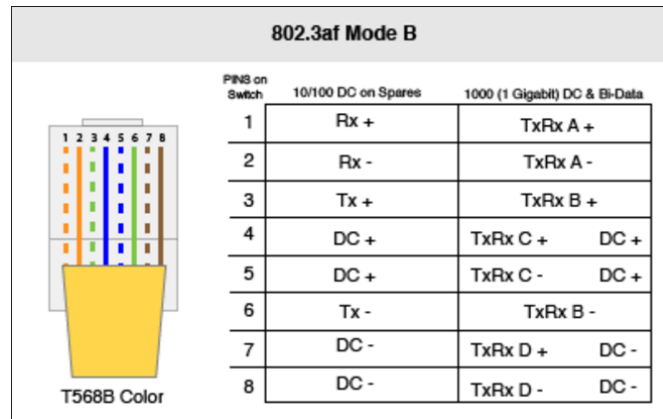
Caution!

Absolute maximum DC voltage +57 V. A higher DC voltage value will permanently damage the equipment!

6.3 SkyStation Start-up and Connection

6.3.1 Apply POE power to the SkyStation

At power-up an IP address will be assigned to the SkyStation by the local DHCP server. By default, the SkyStation will start broadcasting the Control Channel information on port 30012.

6.3.2 Run SkyLinkApp.exe

SkyLinkApp.exe will be listening for incoming Control UDP data on port 30012. When the data arrives, SkyLinkApp.exe will begin graphing the radio link statistics.

NOTE: If you are not seeing the graphing as shown below it is likely your firewall is blocking the broadcast on port 30012. Please setup your firewall to allow SkyLinkApp.exe broadcast access to port 30012.

SkyLinkApp.exe will populate the IP address of the SkyStation as noted with the red arrow below. This is the IP address of the SkyStation which is to be used connection a ground control station like Mission Planner.
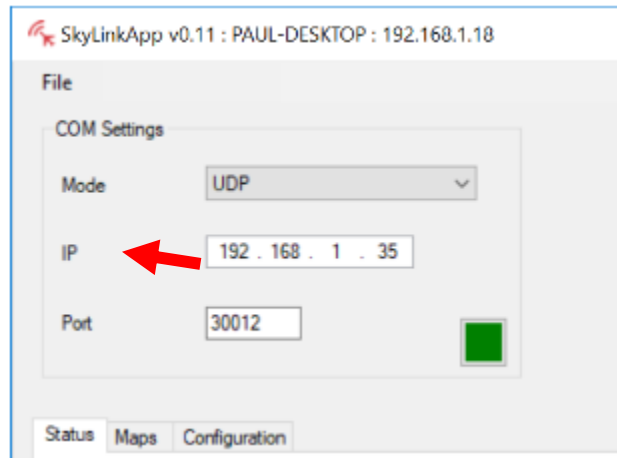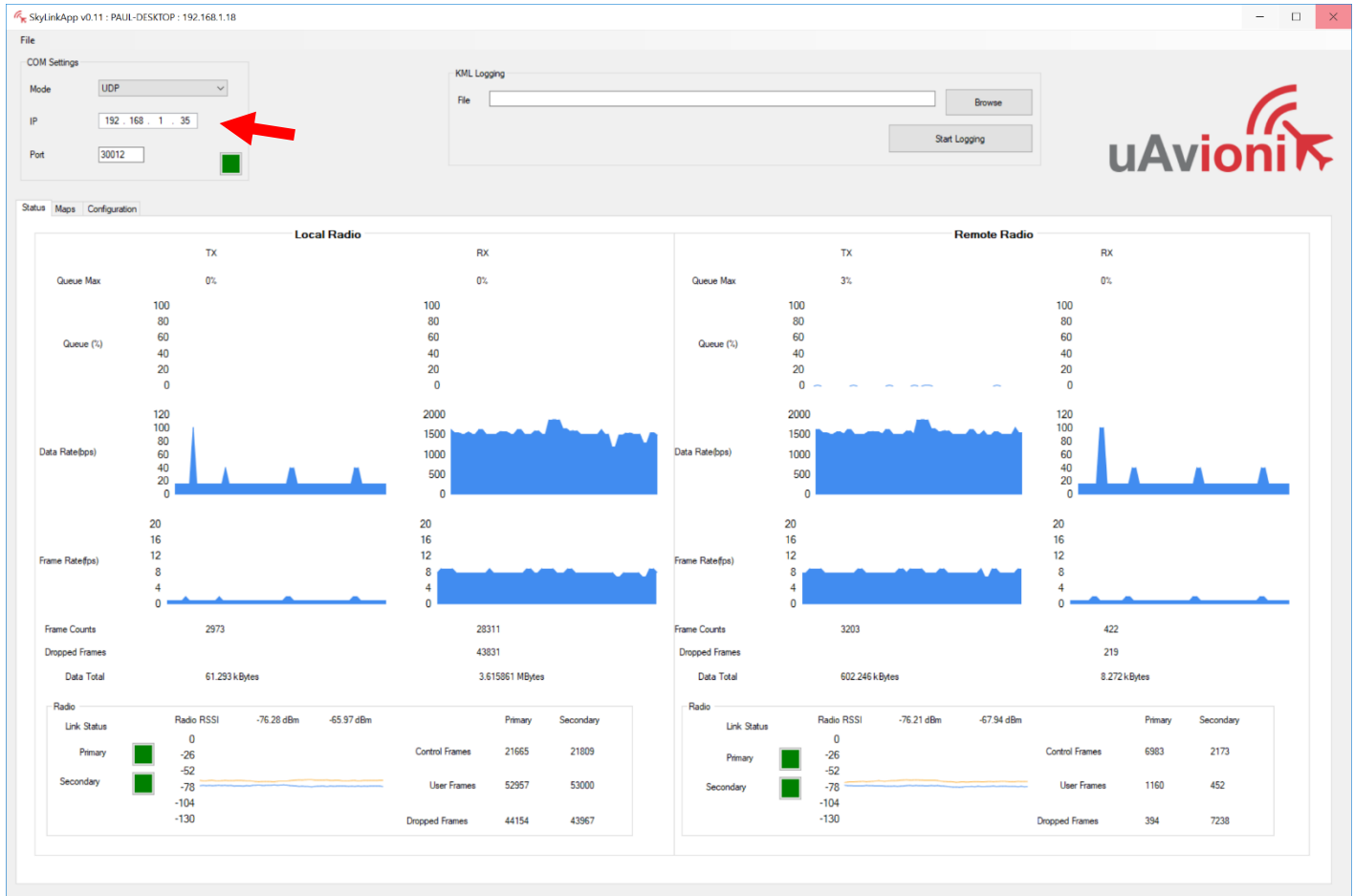
6.3.3 Connect to Mission Planner in TCP mode

Download and install Mission Planner from:

http://firmware.ardupilot.org/Tools/MissionPlanner/

http://ardupilot.org/planner/docs/mission-planner-installation.html

Verify that the flight controller and SkyStation are powered and running and that SkyLinkApp.exe is receiving data. Run Mission Planner and select the communications drop down menu.
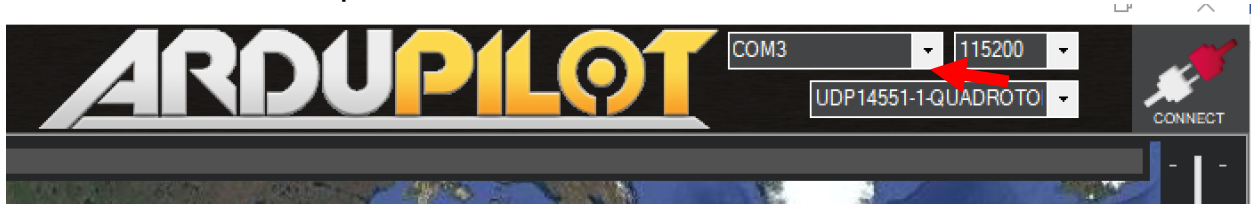
Select TCP as the communication mode and hit the Connect button on the upper right-hand corner.

Enter the SkyStation IP address as found earlier in SkyLinkApp.exe and click OK.
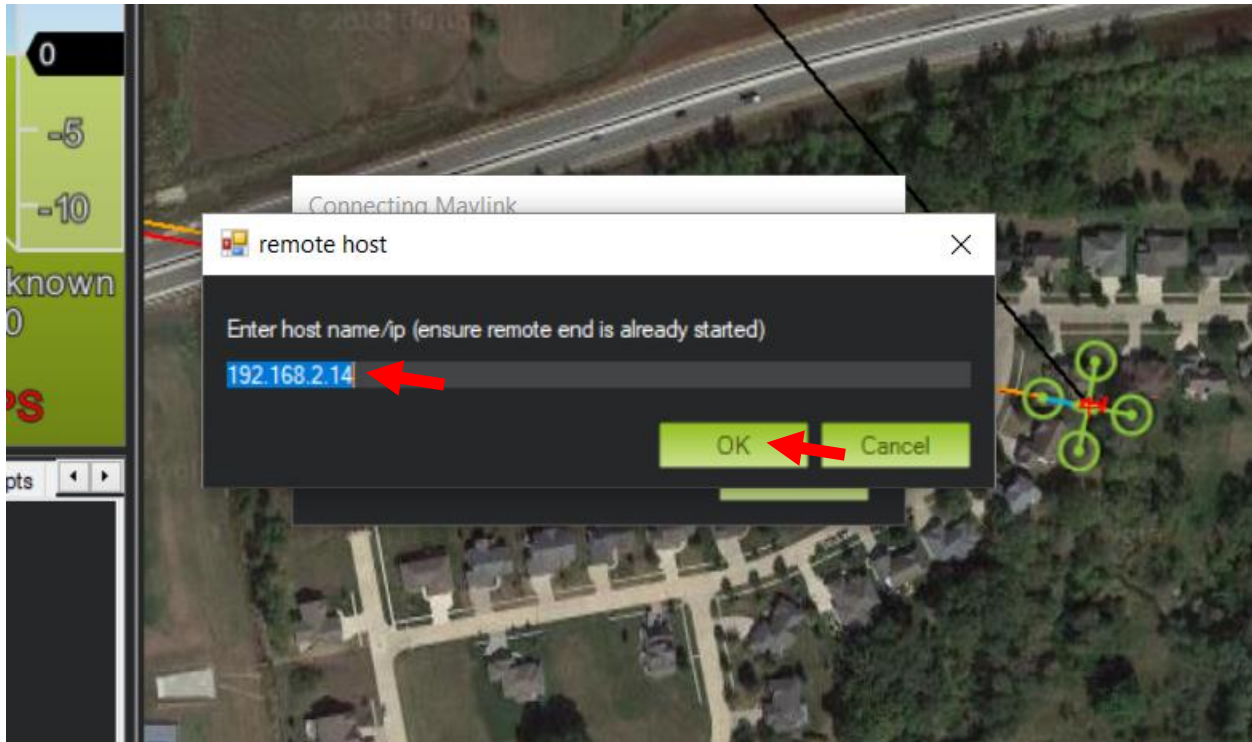
Enter port 30011 which is the SkyStation default TCP port for Mission Planner and click OK.
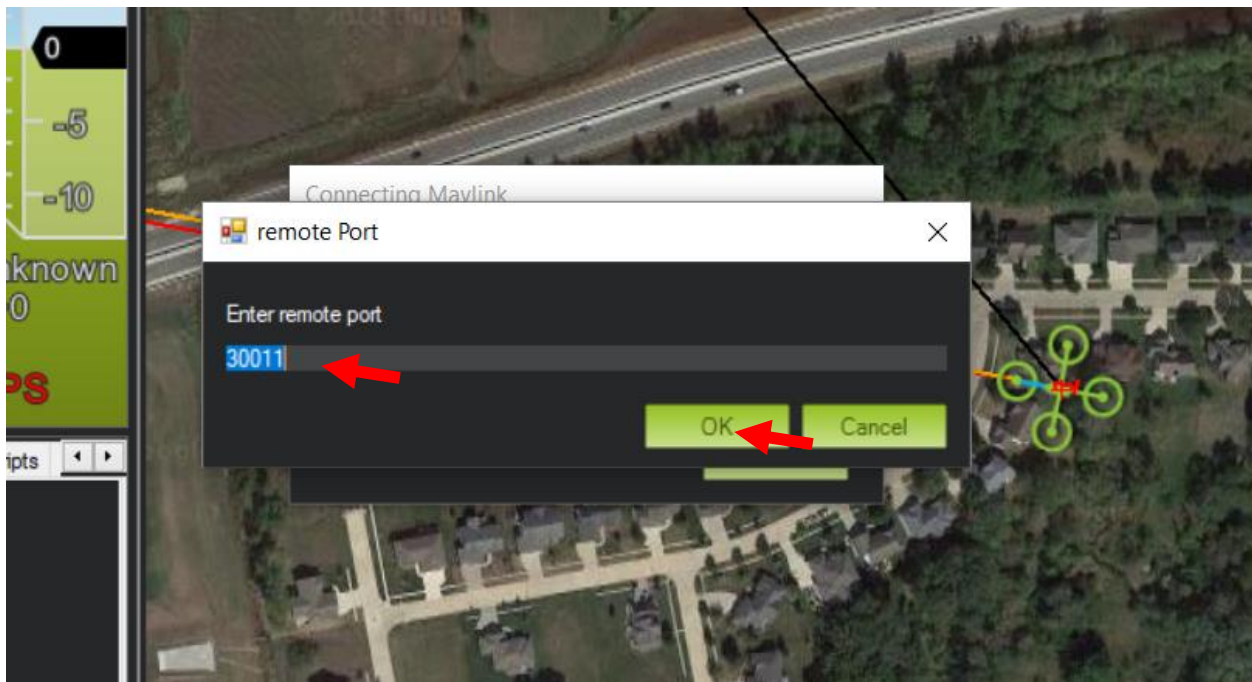
The TCP connection will now take off and you will see the system retrieving parameters as follows for the flight controller.

The SkyStation is now in place and ready to host missions.

6.3.4 SkyLinkApp.exe

SkyLinkApp.exe is the uAvionix Control channel monitoring application. It is used or showing Status, Maps and Configuration information. It can be connected to the SkyStation in TCP or UCP modes and the ports are configurable for network flexibility. The mode and port selection must match the SkyStation Configuration page setup and the IP address is always the IP address of the SkyStation.
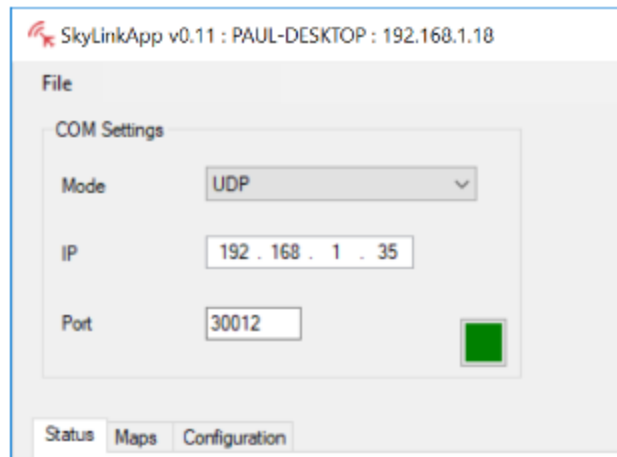
There is also a KML logging feature for importation into mapping software.
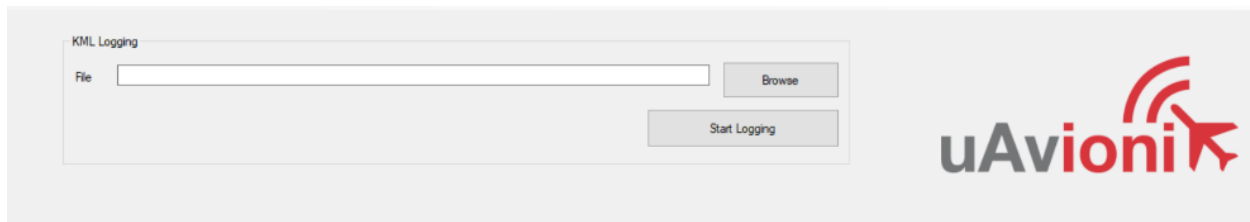
6.3.5 Status Tab

The status data is shown for both the local and the remote radios. It contains both transmit and receive information for the local and remote radios. This information includes memory queue depth information, transmit and receive data rates, frame rates, dropped frames and data totals. It also shows the RSSI's on the primary and secondary radios for both the local and remote radios giving the user comprehensive information on the state of the system.

Status | Maps | Configuration

Local Radio

	TX	RX
Queue Max	0%	0%
Queue (%)	100 80 60 40 20 0	100 80 60 40 20 0
Data Rate(bps)	120 100 80 60 40 20 0	2000 1500 1000 500 0
Frame Rate(fps)	20 16 12 8 4 0	20 16 12 8 4 0
Frame Counts	2973	28311
Dropped Frames		43831
Data Total	61.293 kBytes	3.615861 MBytes

Radio

Link Status	Radio RSSI	-76.28 dBm	-65.97 dBm		Primary	Secondary
Primary	0 -26 -52			Control Frames	21665	21809
Secondary	-78 -104 -130			User Frames	52957	53000
				Dropped Frames	44154	43967

Remote Radio

	TX	RX
Queue Max	3%	0%
Queue (%)	100 80 60 40 20 0	100 80 60 40 20 0
Data Rate(bps)	2000 1500 1000 500 0	120 100 80 60 40 20 0
Frame Rate(fps)	20 16 12 8 4 0	20 16 12 8 4 0
Frame Counts	3203	422
Dropped Frames		219
Data Total	602.246 kBytes	8.272 kBytes

Radio

Link Status	Radio RSSI	-76.21 dBm	-67.94 dBm		Primary	Secondary
Primary	0 -26 -52			Control Frames	6983	2173
Secondary	-78 -104 -130			User Frames	1160	452
				Dropped Frames	394	7238

Radio throughput and statistics detail shown below.

Local Radio throughput and statistics chart showing TX and RX columns.

	TX	RX
Queue Max	0%	0%
Frame Counts	2973	28311
Dropped Frames		43831
Data Total	61.293 kBytes	3.615861 MBytes

RSSI detail shown below.

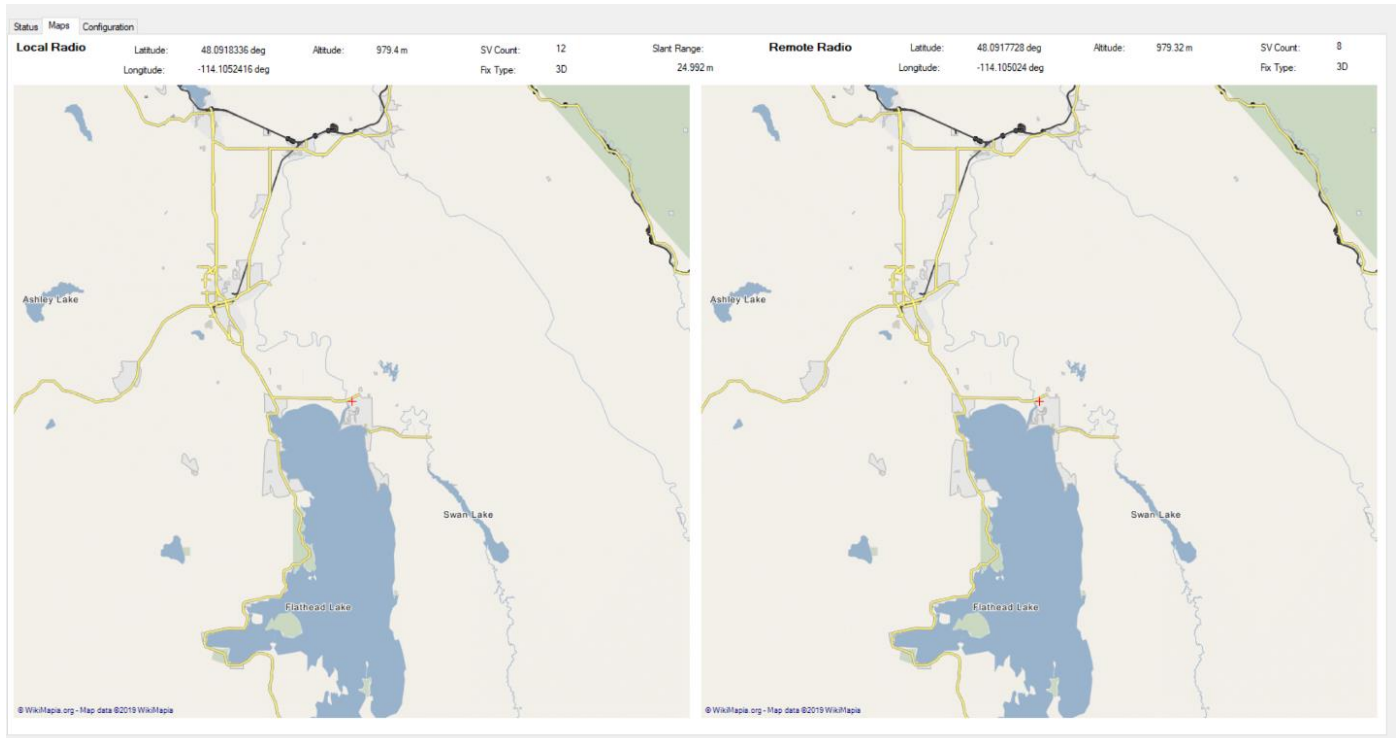| Radio		Radio RSSI	-76.28 dBm	-65.97 dBm		Primary	Secondary
Link Status							
Primary	[green]				Control Frames	21665	21809
Secondary	[green]				User Frames	52957	53000
					Dropped Frames	44154	43967
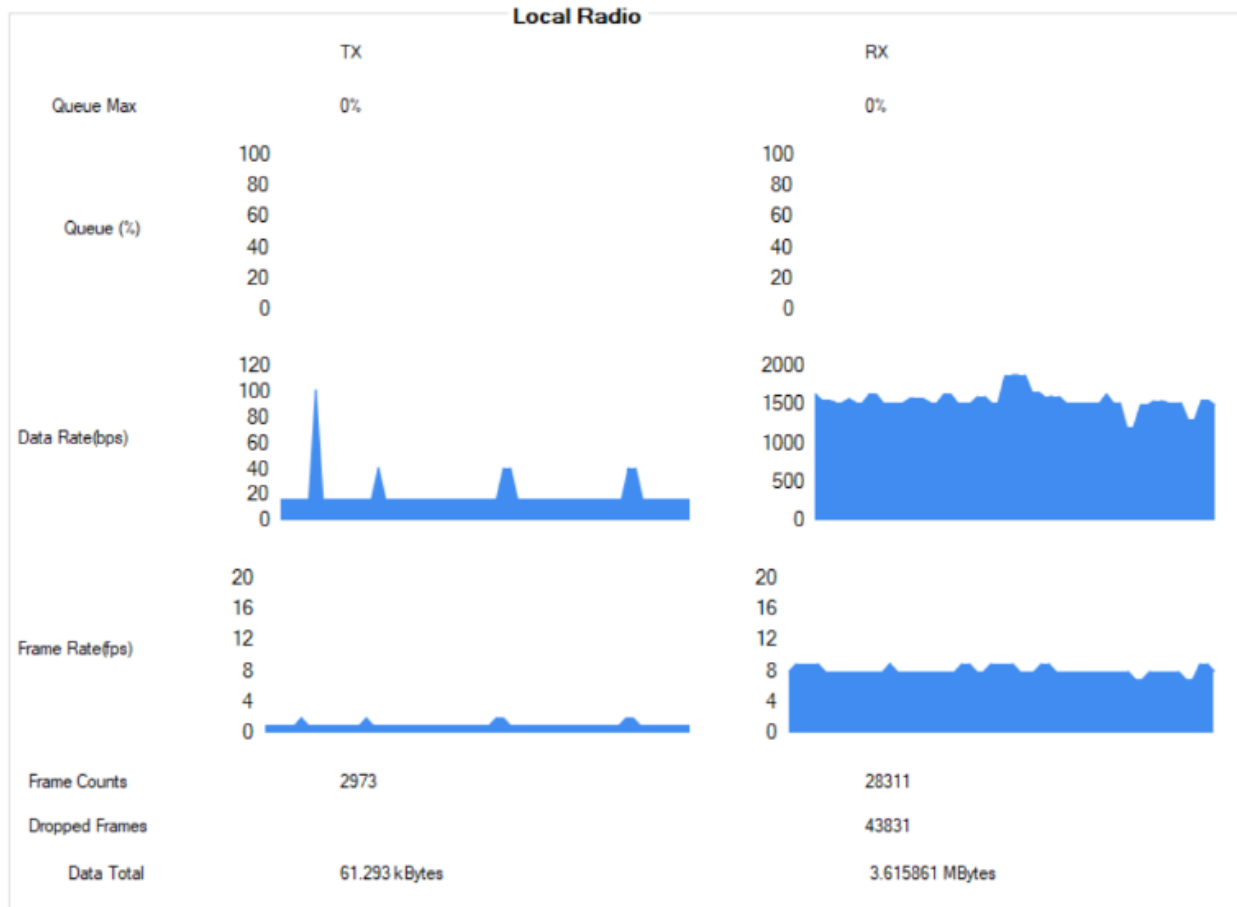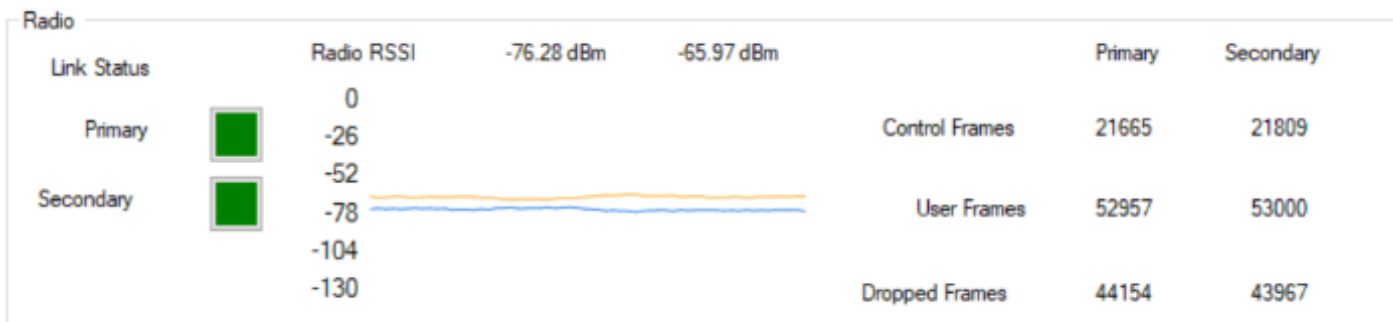
6.3.6 Maps Tab

SkyLinkApp.exe has a mapping tab for mapping the local radio SkyStation radio as well as the remote aircraft radio. It includes latitude, longitude, altitude, GPS fix type, Slant Range and SV count.

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Status | Maps | Configuration

| Local Radio | Latitude: | 48.0918336 deg | Altitude: | 979.4 m | SV Count: | 12 | Slant Range: | | Remote Radio | Latitude: | 48.0917728 deg | Altitude: | 979.32 m | SV Count: | 8 |
| | Longitude: | -114.1052416 deg | | | Fix Type: | 3D | 24.992 m | | | Longitude: | -114.105024 deg | | | Fix Type: | 3D |

6.3.7 Configuration Tab

SkyLinkApp.exe also contains a Configuration page. This page is used for device settings and setup as well as system selecting the hop table scheme for the system.

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Frequency	Sync Word
922.75	0x3690C782
917.25	0x8817133B
917.75	0xF4DA06DB
905.00	0x864FCCD1
922.00	0x805A36B4
921.25	0x3D707C94
926.25	0x71487AC9
915.50	0x03BC6E8A
914.75	0xD0D28EBC
909.00	0xA7FF20CA
921.75	0xD0D28EBC
919.75	0x7A4464D3
918.25	0x805A36B4
912.25	0x24F5DDF8
919.50	0xB83DB5BE
925.00	0xF1943021
916.50	0xD0D28EBC
923.00	0xC8310FB8
920.25	0xB83DB5BE
905.25	0x1E6AF037
911.25	0x8CFA479B
911.50	0xEF039589
919.00	0x58B5B3DD
922.50	0x03BC6E8A
916.25	0x595EE8F0
915.75	0x0E28F1B0
924.50	0xC0908FBB
907.75	0x501433DE
922.25	0x9DA54FB7
920.00	0x527B11D4
902.75	0x17FF9E21
926.50	0x148DB580
926.00	0x08F849E7
923.50	0x5F303B56
908.50	0x595EE8F0
923.75	0x07BD9F26
909.50	0x03BC6E8A
912.50	0x24F5DDF8
908.75	0x80692680
913.50	0x5FBD4093
921.50	0x7A4464D3
914.00	0x35D1FC97

Hop Table Selector: Static

Load Hopping Table From File

Save Hopping Table To File

Randomly Generate Hopping Table

Default to ISM Hopping Table

Get Hop Table From Device | Save Hop Table To Device | Get Device Configuration | Save Device Configuration

Device Settings

Station Type: Ground

UTC Pulse Polarity: Positive

User Port Baud Rate: 57600

GPS Port Baud Rate: 115200

Control Port Baud Rate: 115200

○ Frame on Uart Idle
◉ Frame when Stale

Framer MTU: 240

6.3.7.1 ARS Configuration
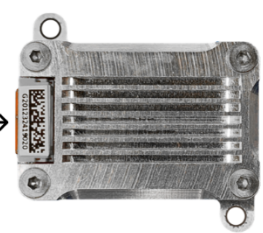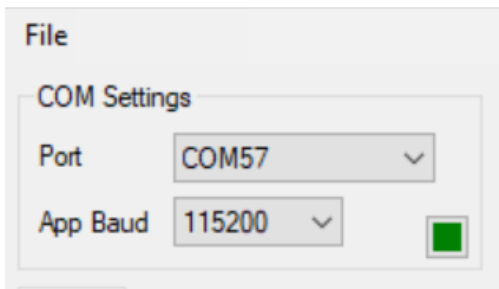
Connect as shown below then run the SkyLinkApp.

PC

USB   6pGH

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Select Port and set the App Baud to 115200.

On the Configuration Tab:

- Default to ISM Hopping Table
- Save Hop Table to Device
  - Station Type: Airborne
  - UTC Pulse Polarity: Positive
  - User Port Baud Rate: 57600
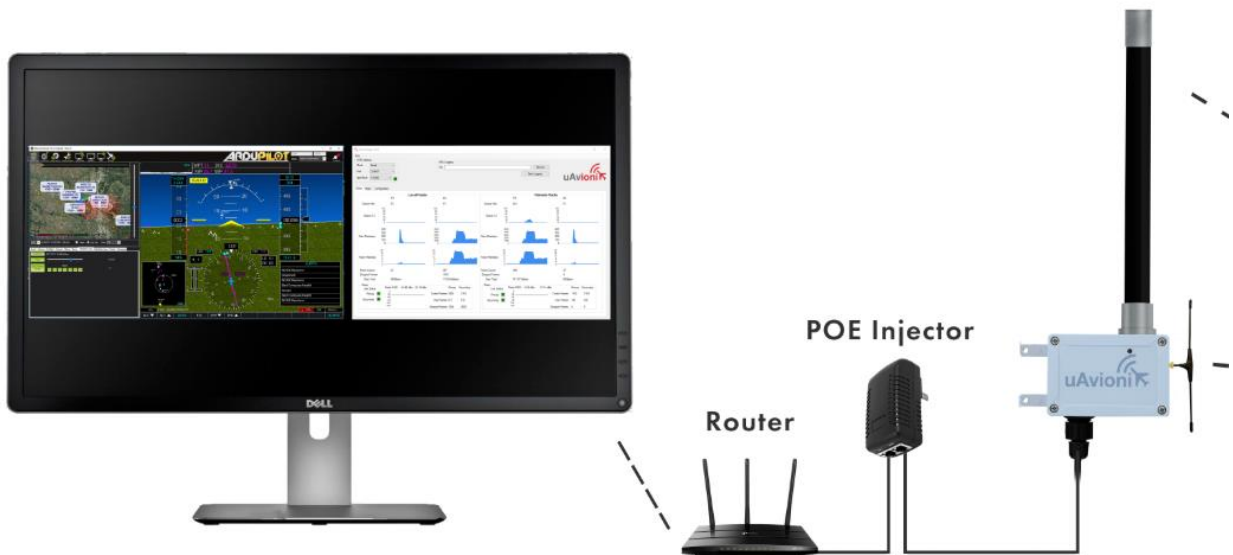 - GPS Port Baud Rate: 115200
  - Control Port Baud Rate: 115200
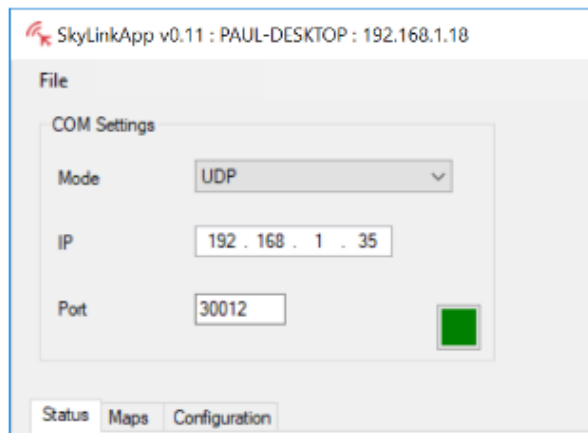 - Check Frame When Stale
  - Framer MTU: 240
- Save Device Configuration

6.3.7.2 GRS Configuration

Connect as shown below then run the SkyLinkApp.

Select Port and set UDP / TCP as configured.

On the Configuration Tab:

- Default to ISM Hopping Table
- Save Hop Table to Device
  - Station Type: Ground
  - UTC Pulse Polarity: Positive
  - User Port Baud Rate: 57600
  - GPS Port Baud Rate: 115200
  - Control Port Baud Rate: 115200
  - Check Frame When Stale
  - Framer MTU: 240
- Save Device Configuration

6.4 SkyStation Configuration and Health Webpage

SkyLinkApp.exe will give the IP address of the SkyStation. The SkyStation IP address can be also be determined without SkyLinkApp.exe by accessing the local DHCP server and reviewing the connected devices or by using industry accepted network scanning tools. Directions for each DHCP server, router, or network scanning tool differ. Refer to the instruction manual for these devices or tools to help determine the IP address assigned to the SkyStation. The MAC address for each SkyStation can be found on the device housing.

The following pages can be viewed in your web browser.

Note nnn.nnn.nnn.nnn is the IP address of the SkyStation.

- SkyStation base URL:

    http://nnn.nnn.nnn.nnn/

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Displays Health statistics, position and version information. Use to program the target UDP address and Port number.

- SkyStation status URL:

  http://nnn.nnn.nnn.nnn/api/v1/stats

  Displays the status json sentence/

- SkyStation update URL:

  http://nnn.nnn.nnn.nnn/update

  Provides ability to update firmware.

The base URL displays configuration items as well as dynamic SkyStation health statistics. The defaults for the User and Control channel connections is shown. All parameters can also be modified to fit your network needs.

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![uAvionix logo]

Configuration

User Connection Type:	☐ UDP ☑ TCP	
User UDP IP Address:	255.255.255.255	
User UDP Port:	30010	
User TCP IP Address:	0.0.0.0	(0.0.0.0 for TCP Server)
User TCP port:	30011	
Control Connection Type:	☑ UDP ☐ TCP	
Control UDP IP Address:	255.255.255.255	
Control UDP Port:	30012	
Control TCP IP Address:	0.0.0.0	(0.0.0.0 for TCP Server)
Control TCP port:	30013	
Static IP Address:	0.0.0.0	(0.0.0.0 for DHCP)
Subnet Mask:	0.0.0.0	
Gateway IP Address:	0.0.0.0	
DNS Address:	0.0.0.0	
Reset Factory Defaults:	☐ RESET	

[Update]

Health

User Serial Total KB Received: 7884   User Serial Bytes/s: 2240   User TCP Bytes Received: 81547   User UDP Bytes Received: 0

Control Serial Total KB Received: 1177   Control Bytes/s: 342   Control TCP Bytes Received: 0   Control UDP Bytes Received: 0

TCP Received: 14030   TCP Transmit: 6644   TCP Drops: 245

Free Space: 29992   Allocated Space: 15064

Version: 0.1.1

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6.4.1 Configuration Items

![uAvionix logo]

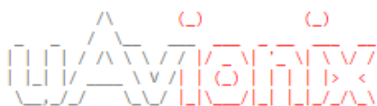| Configuration Item	Description
User Connection Type	These checkboxes indicate a connection type of UDP or TCP to the SkyStation on the User connection. The default will be TCP for the User connection. The User connection is typically a connection to the aircraft ground station software.
User UDP IP Address	When the User Connection Type is UDP, this will be the IP address of the User connection which is typically the ground control software. UDP datagrams will be sent with the IP address specified in this field. The default for this IP address is 255.255.255.255 so the data will be to the broadcast address/
User UDP Port	When the User Connection Type is UDP, this will be the port of the User connection which is typically the ground control software. UDP datagrams will be sent with this port specified in this field. The default User UDP port is 30010.
User TCP IP Address	When the User Connection Type is TCP, this will be the IP address the User connection will use to connect to the aircraft ground station software. This field will not usually be used and will default to 0.0.0.0 for "push" receiver mode. The aircraft ground station will normally connect to the SkyStation via the User TCP port.
User TCP Port	When the User Connection Type is TCP, this will be the port that the TCP server is listening on for incoming connections from the User connection. The User connection is typically connection to the aircraft ground station software and the SkyStation will be a "push" receiver using this port. The default User TCP port is 30011.
Control Connection Type	These checkboxes indicate a connection type of UDP or TCP to the SkyStation on the Control connection. The default will be TCP for the Control connection. The Control connection is typically a connection to the aircraft ground configuration and health software such as SkyLinkApp.exe
Control UDP IP Address	When the Control Connection Type is TCP, this will be the IP address of the Control connection which is typically the aircraft ground configuration and health software. UDP datagrams will be sent with the IP address specified in this field. The default for this IP address is 255.255.255.255 so the data will be to the broadcast address.
Control UDP Port	When the Control Connection Type is UDP, this will be the port of the Control connection which is typically the aircraft ground configuration and health software. UDP

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Configuration Item	Description
	datagrams will be sent with this port specified in this field. The default for the Control UDP port is 30012
Control TCP IP Address	When the User Connection Type is TCP, this will be the IP address the Control connection will use to connect to the aircraft configuration and health ground software. This field will not usually be used and will default to 0.0.0.0 for "push" receiver mode. The aircraft configuration and health software will normally connect to the SkyStation via the User TCP port.
Control TCP Port	When the Control Connection Type is TCP, this will be the port that the TCP server is listening on for incoming connections from the Control connection. The Control connection is typically connection to the aircraft ground station software and the SkyStation will be a "push" receiver using this port. The default Control TCP port is 30013.
Static IP Address	Fixed IP address number of the device which will not change. The network administrator assigns this number. Set this field to 0.0.0.0 to enable DHCP.
Subnet Mask	Mask used to the IP address into network and host address.
Gateway IP Address	Address used to send packets out of the local network.
DNS Address	This is the IP address of the Domain Name Service.
Reset Factory Defaults	By checking this box and hitting the Update button, all connection types, IP Addresses and ports will be restored to the factory default. This function also performs a system reset. The screenshot above documents what the factory defaults are.

Update   When you modify any configuration item, press the Update button to store the changes. These fields are non-volatile and persist through power cycles.

6.4.2 Health

The Health section shows some real time statistics updated once every 2 seconds. It will show if we are sending and receiving serial data and at what rates. It shows TCP/IP stack heath and diagnostic data as well as global memory usage data statistics.

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Configuration

User Connection Type: ☐ UDP ☑ TCP

User UDP IP Address: 255.255.255.255
User UDP Port: 30010

User TCP IP Address: 0.0.0.0 (0.0.0.0 for TCP Server)
User TCP port: 30011

Control Connection Type: ☑ UDP ☐ TCP

Control UDP IP Address: 255.255.255.255
Control UDP Port: 30012

Control TCP IP Address: 0.0.0.0 (0.0.0.0 for TCP Server)
Control TCP port: 30013

Static IP Address: 0.0.0.0 (0.0.0.0 for DHCP)
Subnet Mask: 0.0.0.0
Gateway IP Address: 0.0.0.0
DNS Address: 0.0.0.0
Reset Factory Defaults: ☐ RESET

[Update]

Health

User Serial Total KB Received: 7884   User Serial Bytes/s: 2240   User TCP Bytes Received: 81547   User UDP Bytes Received: 0

Control Serial Total KB Received: 1177   Control Bytes/s: 342   Control TCP Bytes Received: 0   Control UDP Bytes Received: 0

TCP Received: 14030   TCP Transmit: 6644   TCP Drops: 245

Free Space: 29992   Allocated Space: 15064

Version: 0.1.1

About / Copyrights

Statistic	Description
User Serial Total KB Received	This is the total number of bytes received on the User serial channel in Kilobytes

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|	
User Serial Byes/s	This is the current number of bytes per second on the User serial channel
User TCP Bytes Received	This is the total number of TCP bytes received on the User channel when the User Connection type is TCP
User UDP Bytes Received	This is the total number of UDP bytes received on the User channel when the User Connection type is UDP
Control Serial Total KB Received	This is the total number of bytes received on the User serial channel in Kilobytes
Control Bytes/s	This is the current number of bytes per second on the Control serial channel
Control TCP Bytes Received	This is the total number of TCP bytes received on the Control channel
Control UDP Bytes Received	This is the total number of UDP bytes received on the Control channel
TCP Received	This is the total number of TCP packets received by the TCP/IP stack
TCP Transmit	The number of TCP packets send by the stack
TCP Drops	The number of TCP packets dropped by the stack
Free Space	Memory free space
Allocated Space	Memory used space
Version	The version of software this SkyStation running.

6.5 Updater

The SkyStation supports software upgrades thru a web-based flashing system. The user will launch the update webpage, select a firmware binary file and press a button to start the update process. The update process is started by launching http://nnn.nnn.nnn.nnn/update
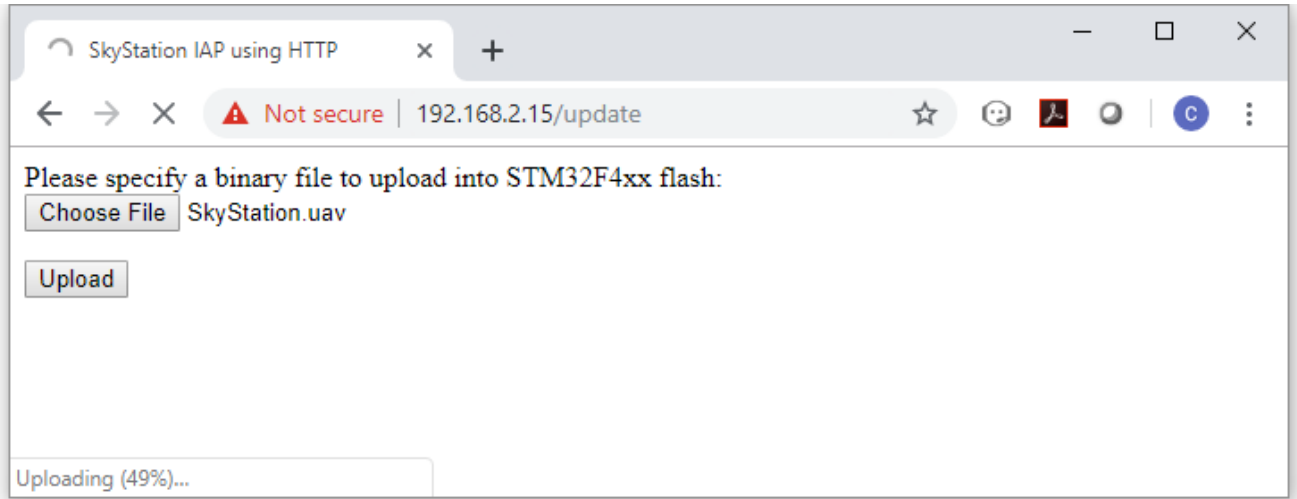
Note nnn.nnn.nnn.nnn is the IP address of the SkyStation.

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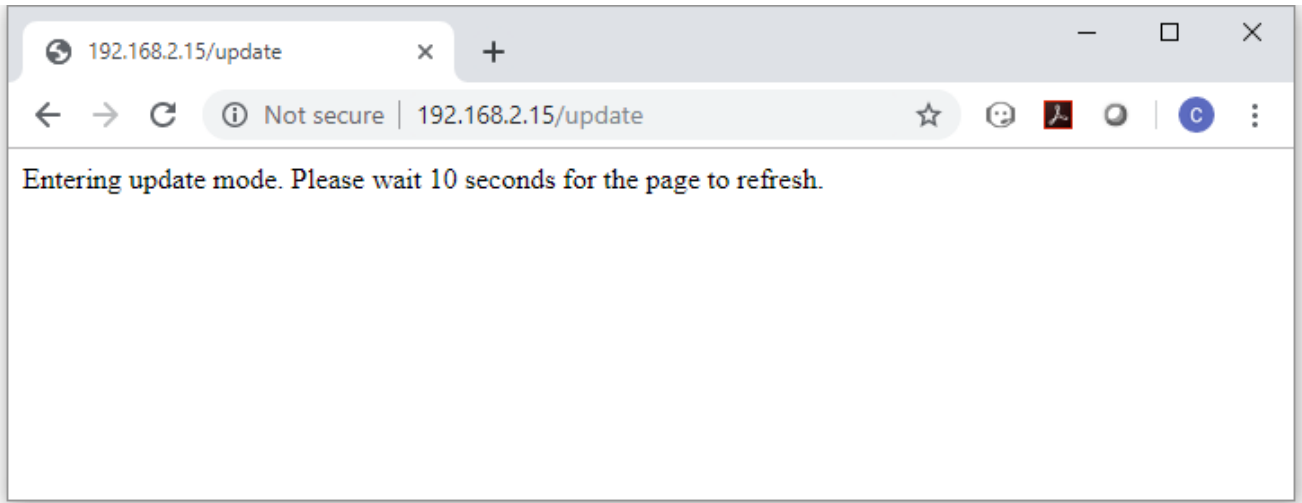
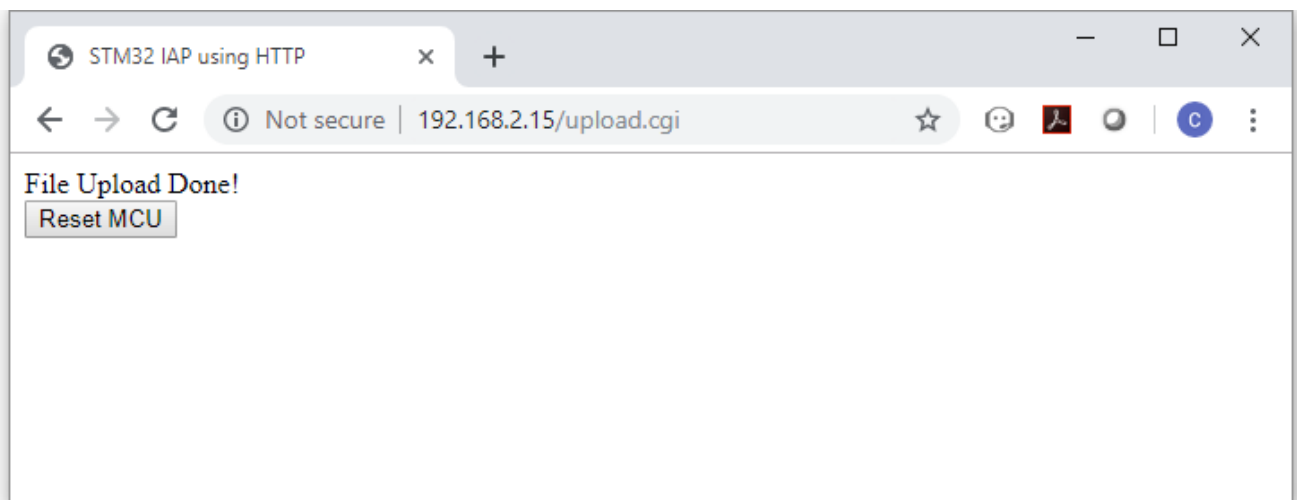Select the "SkyStation.uav" file to upload by pressing the "Choose File" button.
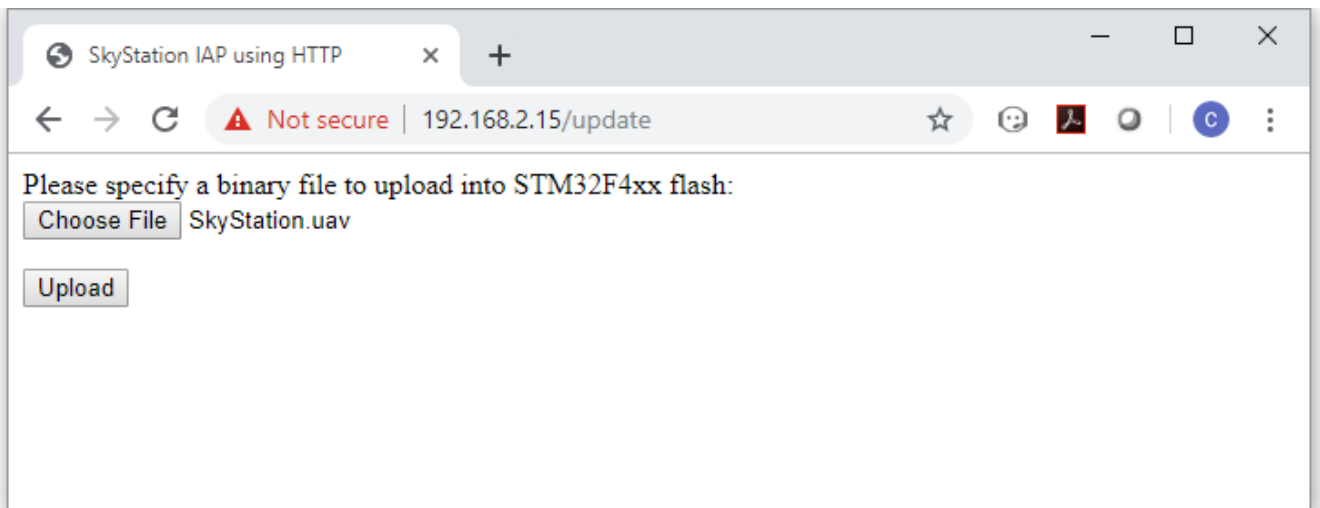
Press to start the upgrade process. There will be an update % status at the bottom of the page.

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When the upgrade is complete you need to press the

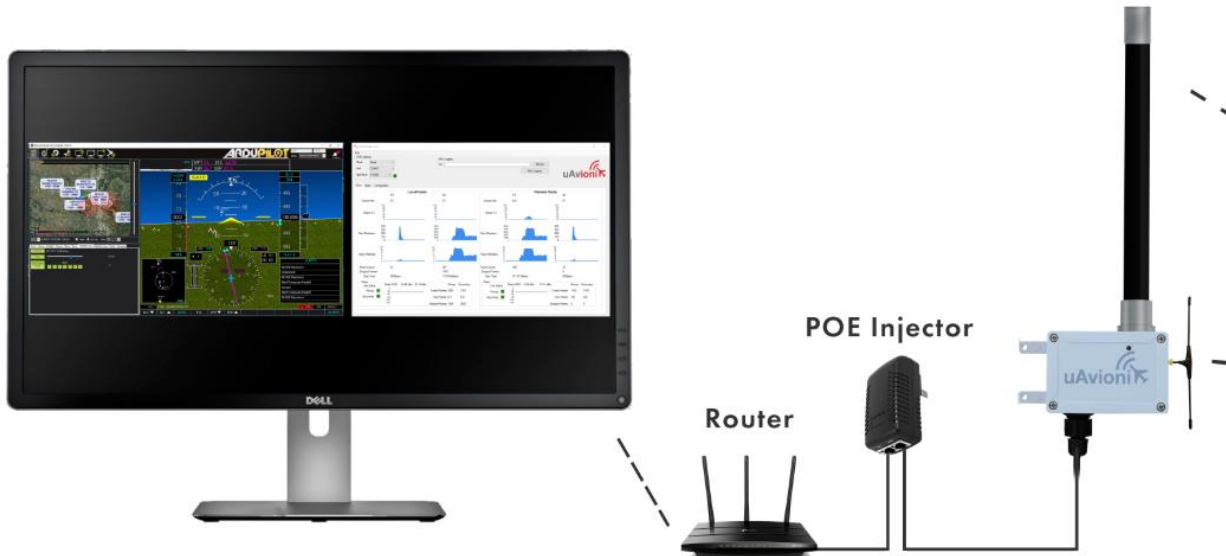 button to restart the SkyStation.

It is recommended that you now power cycle the SkyStation before proceeding.

7 Appendix A Quick Start Guide

- Connect your SkyStation to your command and control network and power it up.


- Connect the User radio port which is the top port on the radio to the Telemetry 1 port on your Pixhawk2.
- Connect the Control radio port which is the bottom port on the radio your truFXY GPS.
- Power on your aircraft flight control system.
- Launch the SkyLinkApp.exe application available at www.uavionix.com and use it to validate communications as well as retrieve the SkyStation IP address the DHCP server gives the SkyStation for connecting to Mission Planner.
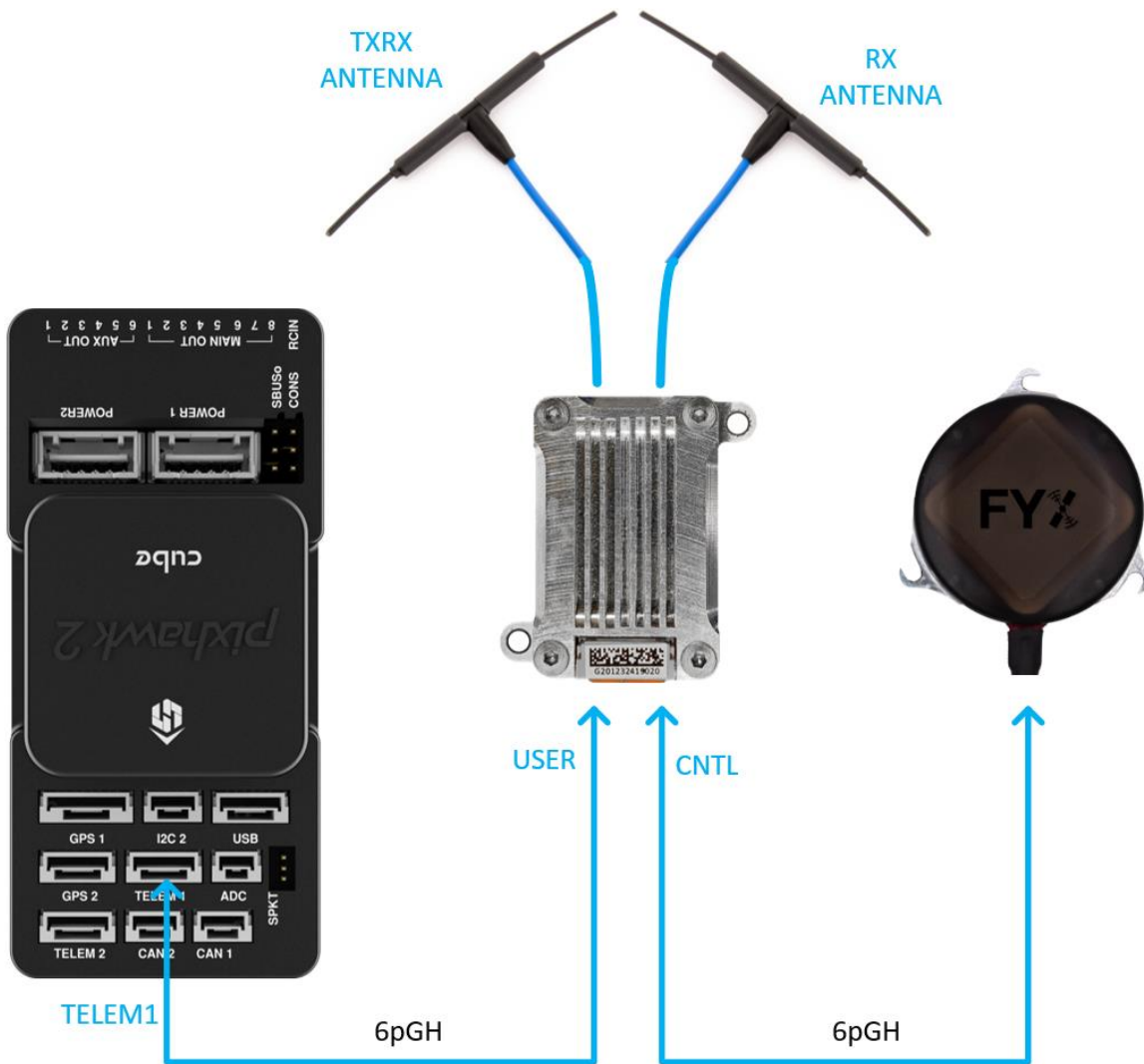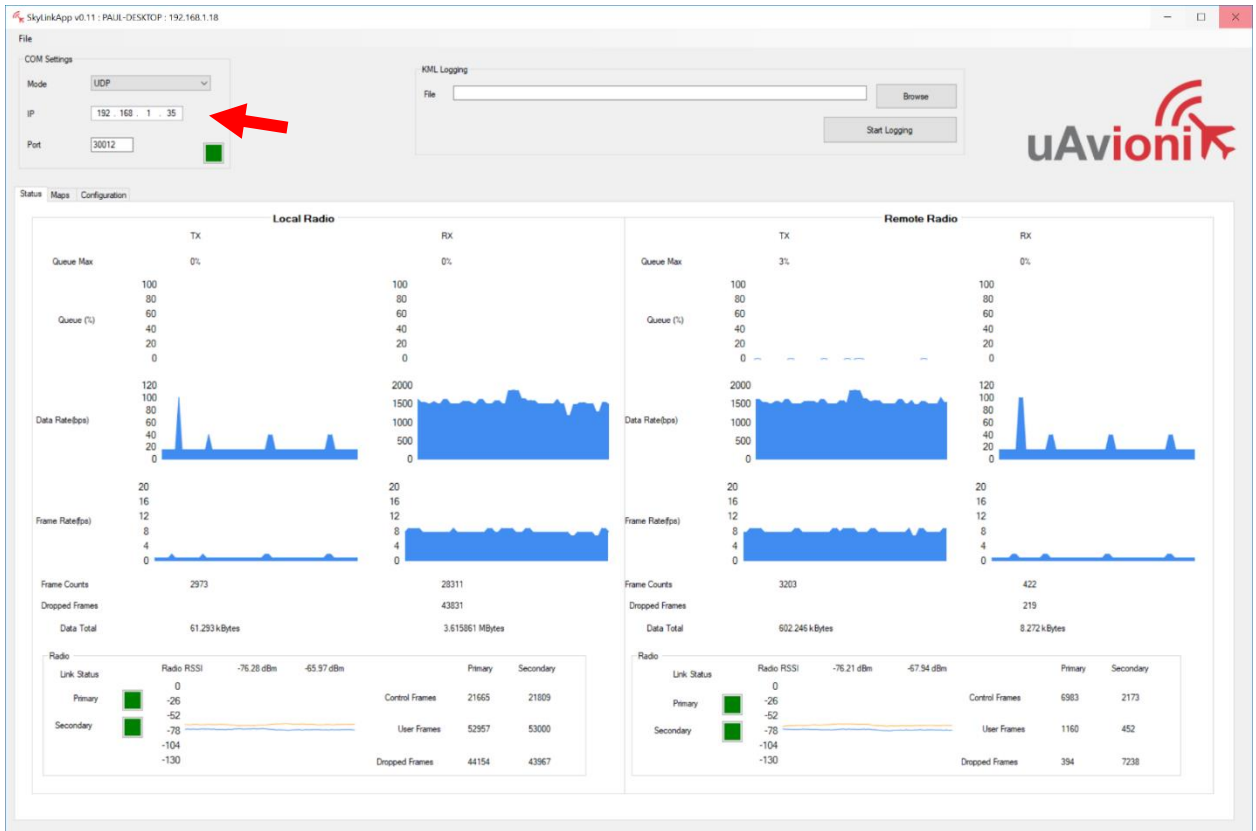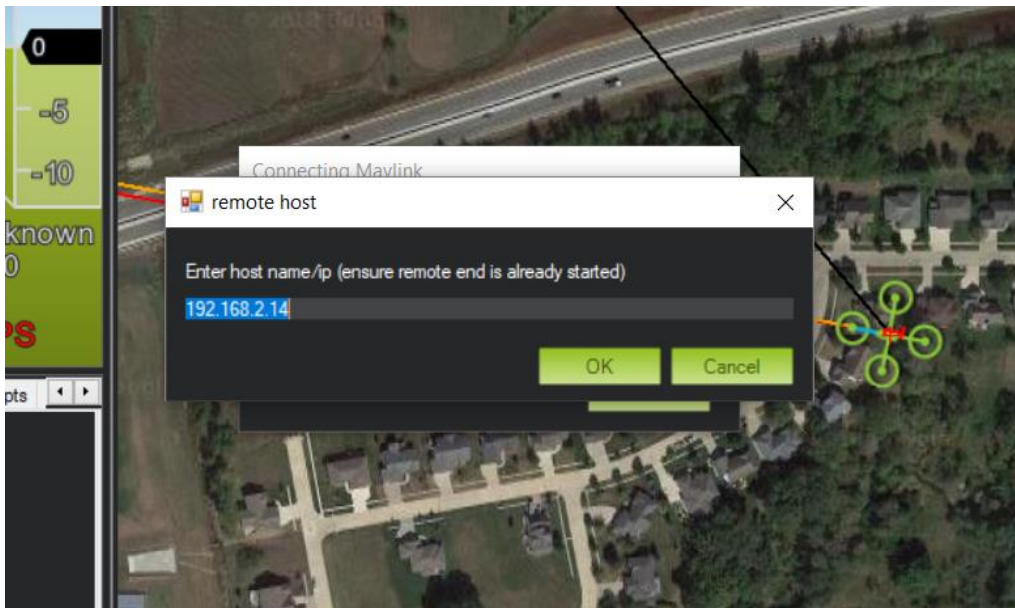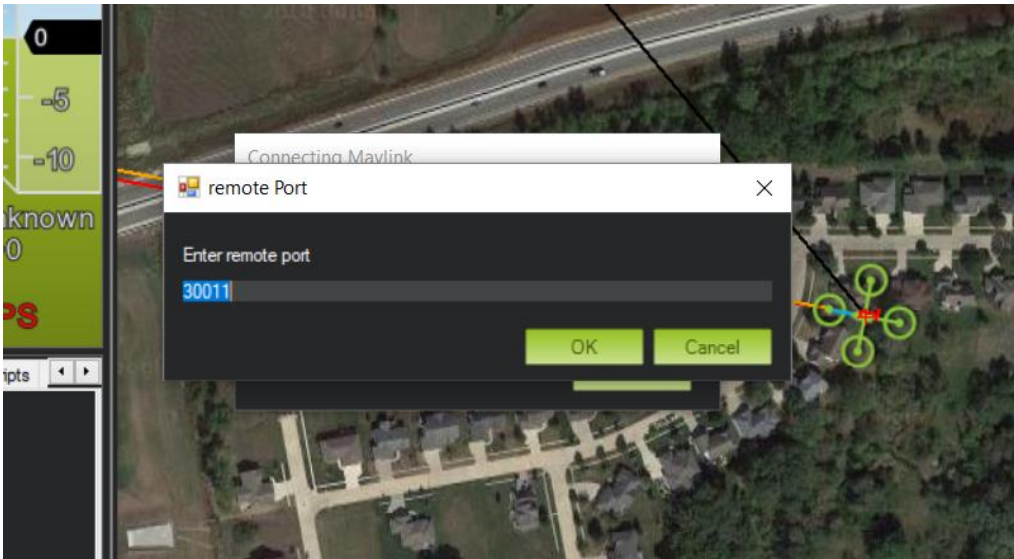
- Connect Mission Planner to the SkyStation using a TCP connection to the SkyStation IP Address and the default SkyStation TCP port of 30011.
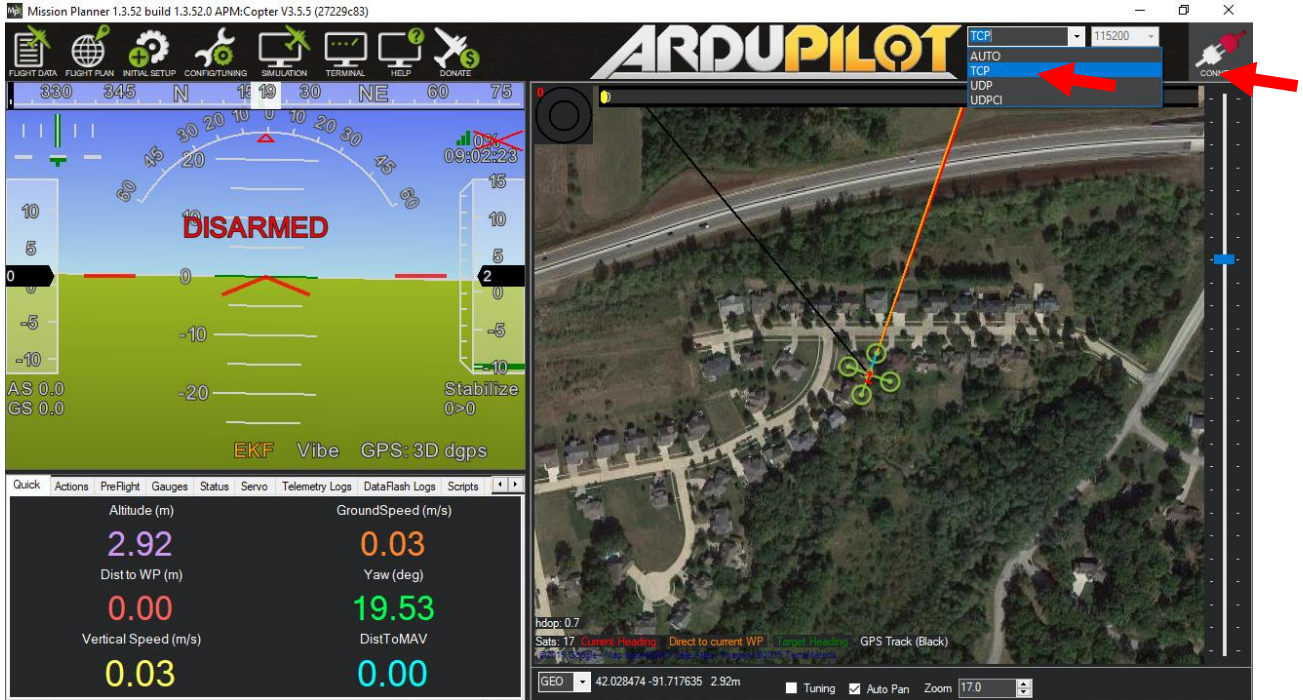
- Use the IP address of the SkyStation obtained from the SkyLinkApp or from your list of DHCP connected devices.
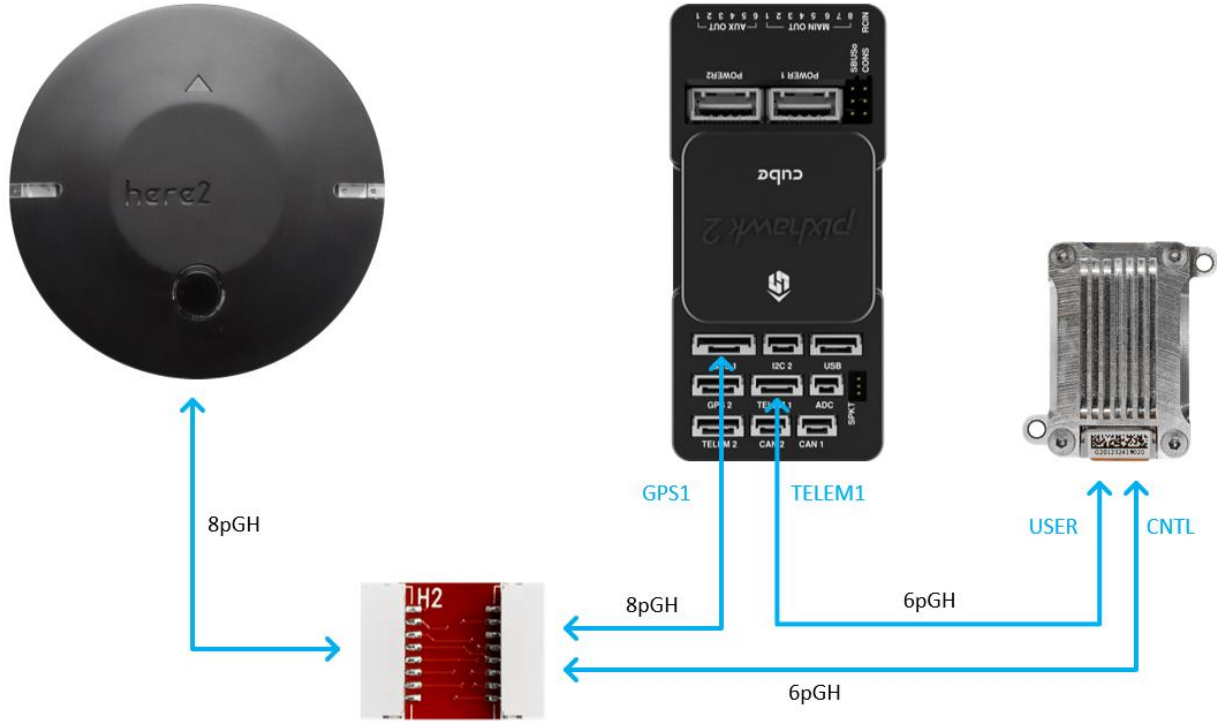

- Use the SkyStation default port of 30011.

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- Once connected and all the parameters are downloaded you are ready to plan your mission and fly!

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8 Appendix B HERE2 GPS Sharing

HERE2 GPS Sharing shown below.

HERE2 GPS PCB

Jumper Pin 6 to the
'1PPS' Test Point
Blue Wire (shown)